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(54) HEAT SEALING APPARATUS

(71) We, BRITISH CELLOPHANE LIMITED, a British Company, of Bath Road, Bridgwater, Somerset, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

This invention is concerned with heat-sealing apparatus and, in particular, with apparatus for forming continuous heat-seals in a travelling film.

In the manufacture of filled sealed packages formed from flexible heat-sealable sheet wrapping material by a continuous process, it is well-known to draw a continuous sheet of the wrapping material over a former to bring the sheet into the form of a tube with the longitudinal edge margins in an overlapping relationship and then forming a continuous longitudinal heat-seal along the overlap. The tube is next heat-sealed transversely at spaced positions along the tube, goods being inserted in the tube between each heat-sealing operation, and individual sealed packages are separated from the tube by cutting through the transverse heat-seals. Examples of suitable sheet wrapping materials are heat-seal coated cellulose film, polyethylene film, heat-seal coated polypropylene film, polyvinyl chloride, copolymers of vinyl chloride, and copolymers of vinylidene chloride.

A common method for forming the longitudinal seal at the overlap of the tube-forming packaging material is to cause the overlapping edge margins to pass between a base plate known as the "anvil" which may be covered with a silicon-rubber coating or sleeve, and a heated sealer bar which is pressed against the anvil and which is known as a heated "shoe".

This sealing apparatus is quite satisfactory for many wrapping materials but difficulties are experienced with some plastics films, for example, heat-seal coated polypropylene film, which under the conditions of heat and drag when passing between the shoe and the anvil, tend to shrink in the direction of travel of the film causing transverse wrinkles. Undesirable drag marks are formed upon the film surface and the wrinkles cause undesirable breaks to be formed in the heat-seal.

Sealing the overlap of heat-sealable wrapping material wrapped around packages by directing one or more jets or streams of heated air or gas onto the overlap has been described in British Patent Specification No. 713,662. This sealing method has the disadvantages of uneven sealing due to the difficulties in maintaining the conditions constant. Further, since the air passing from the nozzles enters a low pressure zone, high velocity jets are required to provide the necessary sealing pressure at the overlap. This necessitates the provision of large volumes of heated air and as a consequence, the operating costs are high.

The present invention is concerned with an improved heat-sealing apparatus in which the above-mentioned problems are substantially eliminated.

According to the present invention there is provided a heat-sealing apparatus for forming a continuous heat-seal between at least two overlapping portions of a travelling heat-sealable sheet wrapping material, which apparatus comprises a base plate over which the overlapping portions of the sheet wrapping material are drawn, an air chamber placed opposite the base plate with an outlet facing the base plate for maintaining an air-cushion between the air chamber and the sheet material passing over the base plate, an air supply means for supplying air under pressure to the chamber and a heater for heating the air supplied to the chamber to a temperature above the heat-sealing temperature of the sheet wrapping material, the gap between the air chamber and the base plate through which air escapes from the air-cushion to the atmosphere being of such dimensions that it provides the principal restriction to flow of air in the path between the air supply means and the atmosphere.

By means of the apparatus of the invention, the overlapping portions of the travelling

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sheet material passing over the base plate are smoothly pressed together by the air cushion maintained between the air chamber and the base plate and are heat-sealed by the heat contained within the air cushion. The friction applied to the travelling sheet material is at a minimum and thus wrinkling and friction lines due to drag are substantially eliminated. The width of the heat-seal is determined by the width of the air-cushion which, in turn is determined by the width of the air-chamber.

The gap between the air chamber and the base plate is preferably as small as is practicable to permit the smooth travel of the wrapping material through the gap and yet provide the maximum restriction to escape of air from the air-cushion maintained in the gap. In practice, a convenient size for the gap is within the range between 0.0005 and 0.010 inch.

In one form of the invention the air chamber is a box having as the outlet one open side which faces the base plate. Heated air supplied to the chamber under pressure escapes to atmosphere through the gap between the edges of the open side and the base plate and due to this restriction forms between the chamber and the base plate a high pressure heated air-cushion.

On passing two portions of heat-sealable wrapping material between the base plate and the chamber, the overlapping portions are pressed firmly together by the air-cushion and are heat-sealed by heat maintained within the cushion.

Since the major restriction to the flow of air from the air supply means to the atmosphere occurs beyond the air-cushion, the pressure of the air in the air-cushion is substantially that of the supply and is adequate for sealing pressure without the necessity to use high velocities as in the prior art. Consequently, the air flow required is low compared with prior art practice with a consequent saving in cost of the supply of air and of heat.

In a modified form of the invention, the side of the air chamber which faces the base plate is closed except for a row of apertures or slots or a single slot in line with the direction of travel of the sheet wrapping material which are considerably larger than the gap between the chamber and the base plate so that restriction to flow of air through the apertures or slots is small compared with the restriction offered by the gap. In practice, the apertures or slots are of the order of 0.25 inch in width. By the use of apertures or slots as the outlet of the air chamber, a sharply defined heat-seal can be obtained.

The air chamber may be conveniently fed with air under pressure from a compressor, for example, at a pressure in the range between 0.5 to 30 pounds per square inch depending on the particular application and the air may be heated by passing through a heat-exchanger. The air-cushion may be further heated by maintaining the air chamber at an elevated temperature. Still further, the base plate may be heated to reduce cooling in the sealing zone to a minimum.

The apparatus is particularly useful in the formation of a longitudinal seal along the overlapping edges of a travelling sheet which has been shaped to form a tube.

The invention also includes a method for forming a heat-seal between at least two overlapping portions of a travelling heat-sealable sheet wrapping material comprising drawing the overlapping portions of sheet wrapping material between a base plate and an air chamber and submitting the overlapping portions to a heated air-cushion maintained between the air chamber and the sheet wrapping material at such a temperature and pressure that the overlapping portions of sheet wrapping material are pressed together against the back plate and are fused together, heated air being supplied to the cushion through the air chamber and the pressure of the air-cushion being maintained by restricting the flow of air from the air-cushion to the atmosphere by the provision of a gap of width between 0.0005 and 0.010 inch between the air chamber and the base plate.

A specific heat-seal apparatus constructed in accordance with the invention will now be described with reference to the drawings filed with the Provisional Specification, in which:

Figure 1 is a front elevation, partly diagrammatic and partly in section, of a packaging machine employing the heat-seal apparatus;

Figure 2 is an enlargement of a section of part of Figure 1 through line A—A;

Figure 3 is a perspective view of part of Figure 1;

Figure 4 is a perspective view of a modified form of the part shown in Figure 3;

Figure 5 is a perspective view of another modified form of the part shown in Figure 3; and

Figure 6 is a perspective view of still another modified form of the part.

Referring to Figures 1, 2 and 3 a continuous sheet 1 of flexible heat-sealable wrapping material (for example, heat-seal coated oriented polypropylene film) about 0.001 inch in thickness is drawn from a supply roll 2 over two guide rolls 3, 4 and around the upper edge 5 of a tube-forming former 6 which shapes the sheet 1 into the form of a tube 1' with overlapping edge margins 7, 8. The overlapping margins 7, 8 on leaving the former 6 pass along a base plate 9 (Figure 2) consisting of a metal strip 10 suspended within the former 6 and covered with

a silicone rubber sleeve 11. Opposite to the base plate 9 is fixed an air chamber 12 having an open side 13 facing the plate 9. A gap 14 formed between the edge 15 of the chamber 12 and the plate 9 is about 0.005 inch, to permit the margins 7, 8 of the sheet 1 to pass freely through. The chamber 12 is supplied with air at a pressure of 25 pounds per square inch from a compressor 16 by way of a pipe 17, an electric heater 18 and a second pipe 19. The air is heated by the heater 18 to a temperature higher than the heat-seal temperature of the sheet 1 and passes out of the chamber 12 to atmosphere by way of the gap 14.

Due to the resistance offered by the gap 14 to the escape of air to the atmosphere, an air-cushion at a pressure of about 13 pounds per square inch is created between the air chamber and the overlapping margins 7, 8 of the sheet 1 which presses the overlapping margins firmly against each other and against the base plate 9. Further since the air is heated above the heat-seal temperature, the surfaces of the margins 7, 8 fuse and form a smooth continuous heat-seal 20.

Since the friction of the sheet 1 over the plate 9 is very small, substantially no drag marks are introduced into the sheet 1 and any shrinkage is accommodated by the sheet 1 without wrinkling.

The sealed sheet 1 now a tube 1' is drawn downwardly away from the plate 9 by reciprocating heat-seal/cutter jaws 21, 22 in a conventional manner. The tube 1' is transversely sealed and cut by the jaws 21, 22 at bag length intervals around goods 23 which are introduced into the tube 1' at suitable intervals.

In Figure 4 is shown a modified form of chamber 12 in which the side 13 is closed except for a series of holes 24 which are 0.25 inch in diameter. In a further modified form of chamber 12 as shown in Figure 5 the holes 24 are replaced by slots 25 which are 0.25 inch in width. Further, in Figure 6 a still further modified form of chamber 12 has a single outlet slot 26 which is 0.25 inch in width.

Whereas the invention has been described with reference to a tube-forming packaging apparatus, it will be understood that the invention can also be applied to heat-sealing two separate travelling sheets together along a strip where edges of the sheets overlap.

WHAT WE CLAIM IS:—

1. A heat-sealing apparatus for forming a continuous heat-seal between at least two overlapping portions of a travelling heat-sealable sheet wrapping material, which apparatus comprises a base plate over which overlapping portions of the sheet wrapping material are drawn, an air chamber placed opposite the base plate with an outlet facing the base plate for maintaining an air-cushion between the air chamber and the sheet material passing over the base plate, an air supply means for supplying air under pressure to the chamber and a heater for heating the air supplied to the chamber to a temperature above the heat-sealing temperature of the sheet wrapping material, the gap between the air chamber and the base plate through which air escapes from the air-cushion to the atmosphere being of such dimensions that it provides the principal restriction to flow of air in the path between the air supply means and the atmosphere.

2. A heat-sealing apparatus as claimed in claim 1 in which the gap between the air chamber and the base plate through which air escapes from the air-cushion to the atmosphere is within the range between 0.0005 and 0.010 inch.

3. A heat-sealing apparatus as claimed in claim 1 or 2 in which the air-chamber is a box having as the outlet one open side which faces the base plate.

4. A heat-sealing apparatus as claimed in claim 1 or 2 in which the side of the air chamber which faces the base plate is closed except for a row of apertures or slots or a single slot in line with the direction of travel of the sheet wrapping material which are considerably larger than the gap between the chamber and the base plate so that the restriction to flow of air through the apertures or slots is small compared with the restriction offered by the gap.

5. A heat-sealing apparatus as claimed in claim 4 in which the apertures or slots are of the order of 0.25 inch in width.

6. A heat-sealing apparatus as claimed in any one of the preceding claims in which the air-supply means is a compressor which is capable of feeding air to the air-chamber at a pressure in the range between 0.5 to 30 pounds per square inch.

7. A heat-sealing apparatus as claimed in any one of the preceding claims in which the air-chamber and/or the base plate may be heated to reduce cooling in the sealing zone to a minimum.

8. A heat-sealing apparatus as claimed in claim 1 substantially as hereinbefore described with reference to Figures 1, 2 and 3 or Figure 4, Figure 5 or Figure 6 of the drawings filed with the Provisional Specification.

9. A tube-forming apparatus for forming a sheet wrapping material into a tube incorporating a heat-sealing apparatus as claimed in any one of the preceding claims.

10. A method for forming a heat-seal between at least two overlapping portions of a travelling heat-sealable sheet wrapping material comprising drawing the overlapping portions of sheet wrapping material between

a base plate and an air chamber and submitting the overlapping portions to a heated air-cushion maintained between the air chamber and the sheet wrapping material at such a temperature and pressure that the overlapping portions of sheet wrapping material are pressed together against the back plate and are fused together, heated air being supplied to the cushion through the air chamber and the pressure of the air cushion being maintained by restricting the flow of air from the air cushion to the atmosphere by the provision of a gap of width between 0.0005 and 0.010 inch between the air chamber and the base plate.

11. A method as claimed in claim 10 in which the heat-sealable sheet wrapping material is heat-seal coated polypropylene film.

12. A method as claimed in claim 10 substantially as hereinbefore described specifically.

13. A method of manufacturing filled sealed packages in which a travelling heat-sealable sheet wrapping material is heat-sealed using apparatus as claimed in any one of claims 1 to 8 or by a method as claimed in any one of claims 10 to 12.

14. A filled sealed package when manufactured by a method as claimed in claim 13.

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1238373 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig.1.

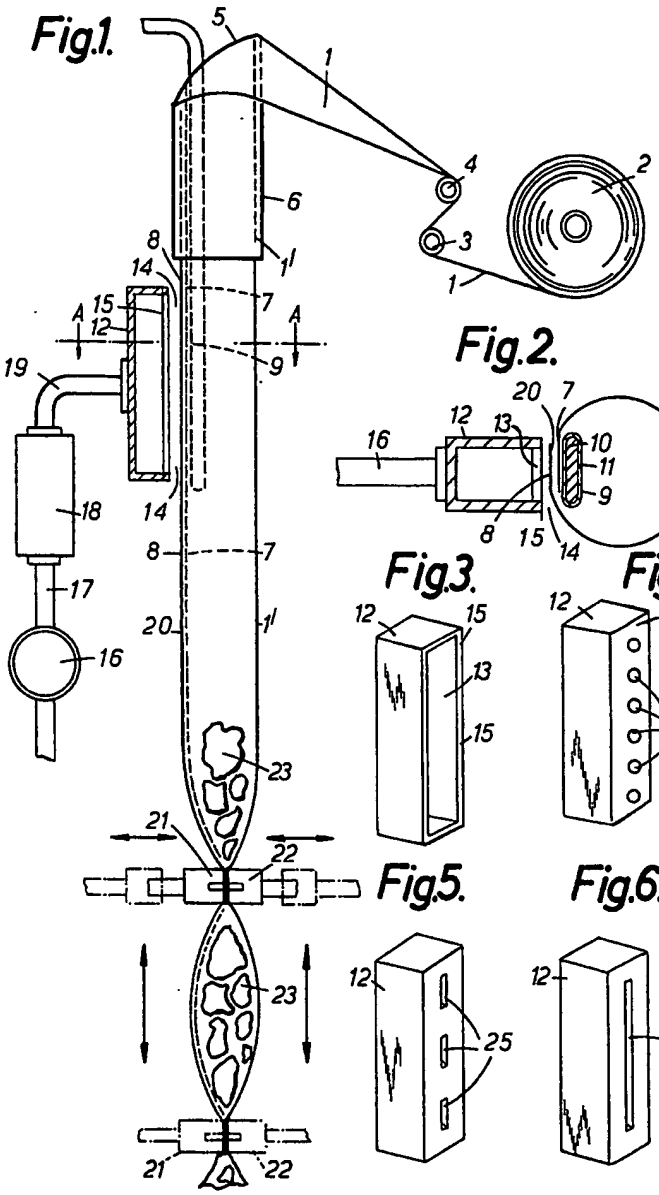

Fig.2.

Fig.3.

Fig.4.

Fig.5.

Fig.6.